Sveriges lantbruksuniversitet
Swedish University of Agricultural Sciences
Institutionen för växtskyddsbiologi
Enheten for integrerat växtskydd

Praktiska erfarenheter med blomsterremsor i äppelodling från forskning & praktik

Trädgårdskonferensen, Linköping 2017.10.24

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Vi berättar om;

Vilka nyttodjur kan gynnas med vilka växter och påverkar det skadegörarna?

Erfarenheter och lärdomar från försök med blomsterremsor i ekologiska kommersiella äppelodlingar ur odlares och forskares perspektiv.

Hur fungerar det praktiskt att ha blomsterremsor i odlingen?

Vilka framtida utvecklingsbehov ser vi och hur kan odlare, forskare och rådgivare samverka?

Experiences from research

Forskningen finansierad av

SLF projektet H1256150 *“Studie av tidsmässig utbredning av naturliga fiender förekommande i trädkronor i svenska äppelodlingar“*

Mario Porcel

Formas projektet 225 - 2013-934 *"Förbättrad bekämpning av skadeinsekter i äppleodlingar genom synergieffekter mellan beteendemodifierande ämnen och biologisk bekämpning där naturliga fiender bevaras och uppförökas”* (Joakim Pålsson & Marco Tasin)

Joakim Pålsson

Marco Tasin

ERA-net CORE Organic Plus, ett nätverk bestående av internationella forskningsprojekt i 20 länder inom området ekologiska livsmedels- och lantbrukssystem.

Weronika Swiergiel

Mario Porcel

År 2014 valde CORE Organic Plus att stödja bl.a. projektet *EcoOrchard* (Weronika Swiergiel, Mario Porcel, Marco Tasin)

Marco Tasin

Sveriges Lantbruksuniversitet Alnarp
Institutionen för växtskyddsbiologi
Enheten för integrerat växtskydd

2015-2017: European CORE Organic Plus Project EcoOrchard

- **9 länder:** Sverige, Danmark, Tyskland, Polen, Lettland, Schweiz, Italien, Frankrike, Belgien

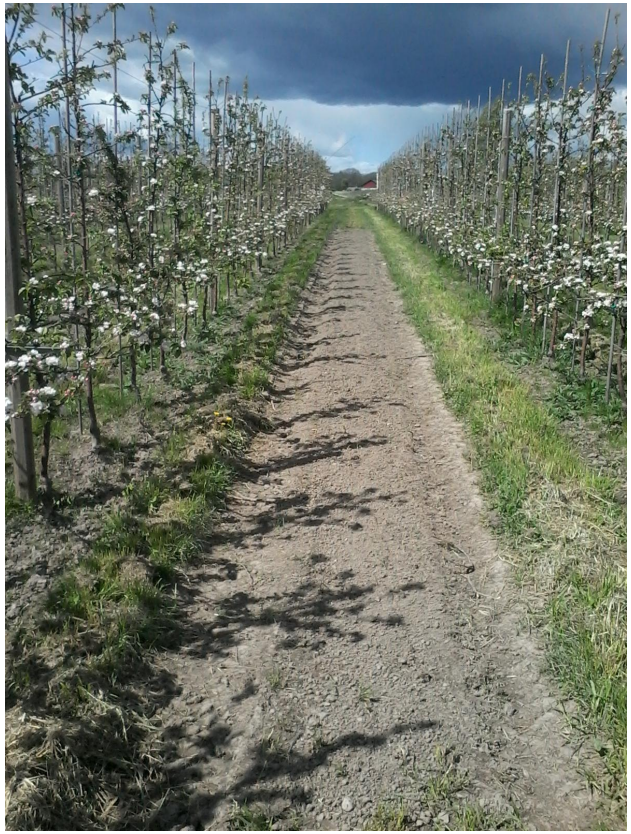
Övergripande mål

Underlätta tillämpningen av metoder som gynnar *funktionell agrobiologisk mångfald* för att skapa robustare fruktodlingar, minska bekämpningsbehovet samt öka den generella biologiska mångfalden till nytta för odlare, konsumenter och miljön.

Mer information om projektet: http://coreorganicplus.org/research-projects/ecoorchard/

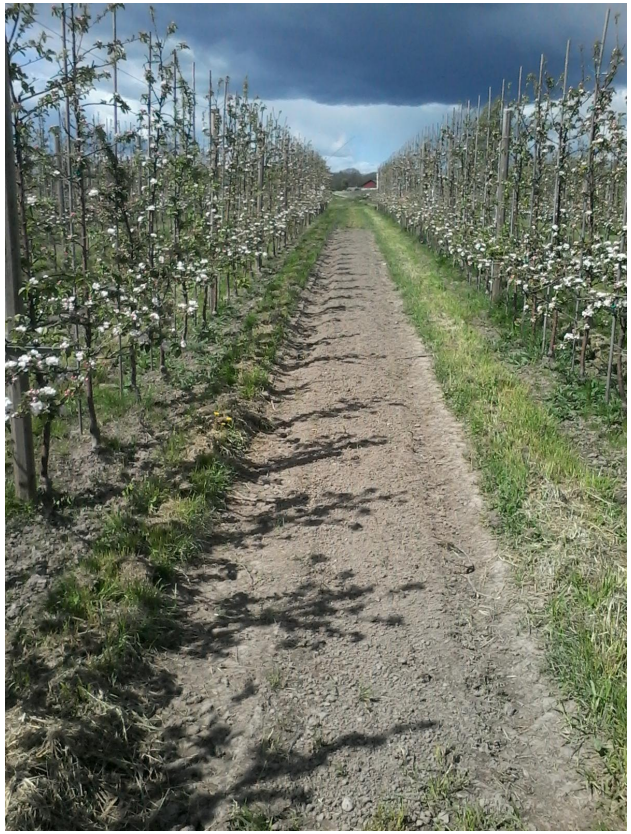
Preparation

- Sown (Nordic countries) in May or August to early September.
- **Probably autumn best (at least soil prep):** higher soil humidity and better germination? Allows enough time for soil cultivation during summer to reduce weeds. Lower weed development in autumn? Some seeds require cold stratification to germinate.
- Tilled soil 3-4 times (“Rotorkultivator”) between Marsh-April (depending on severity of root weed and soil type). Raking (kratta) to remove grassroots if still left the soil
- Adapt soil cultivation to not disturb harvest…



Sowing

- Ensure settling of the soil for 4-6 weeks to allow good contact between the seeds and the soil.
- False seedbed to reduce annual weeds 2x after sowing (possible in Nordic conditions?)
- Sow (no drilling) in mid-May
  - Seed mix of 20% flowers and 80% grass = 5 g/m2. We may need much lower % grass in Nordic conditions though! Pure flower would require 2 g/m2.
- Walter (“Vältra”) after seeding
- Slugproblem? Feramol suggested in Europe



Seed mix

Svenskt namn	Latin
Röllika	Achillea millefolium
Tusensköna	Bellis perennis
Liten blåklocka	Campanula rotundifolia
Kummin	Carum carvi
Rödklint	Centaurea jacea
Grönfibbla	Crepis capillaris
Stormåra	Galium mollugo
Skuggnäva	Geranium pyrenaicum
Rotfibbla	Hypochaeris radicata
Gulvial	Lathyrus pratensis
Höstfibbla	Leontodon autumnalis
Sommarfibbla	Leontodon hispidus
Prästkrage	Leucanthemum vulgare
Käringtand	Lotus corniculatus
Humlelusern	Medicago lupulina
Äkta förgätmigej	Myosotis scorpioides
Lundviva	Primula elatior
Brunört	Prunella vulgaris
Rödblära	Silene dioica
Gökblomster	Silene flos-cuculi
Rödklöver	Trifolium pratense
Häckvicker	Vicia sepium
Morot	Daucus carota
Cikoria	Cichorium intybus
Pimpinell	Sanguisorba minor

Svenskt namn	Latin
Vårbrodd	Anthoxanthum odoratum
Kamäxing	Cynosurus cristatus
-	Festuca guestfalica
Rödsvingel	Festuca rubra rubra Mit.
Engelskt rajgräs	Lolium perenne
Lundgröe	Poa nemoralis
Ängsgröe	Poa pratensis
Kärrgröe	Poa trivialis

In Nordic conditions we probably require a much larger proportion flowering herbs and the species composition needs adaptations to local soil

Management

First year

- 6-8 week after sowing, at plant height of 30-40 cm, cut 7-12 cm from soil. Weeds germinate after 2-3 weeks and sown flowers after 6-8 weeks.

- Next cutting 6-8 weeks later. More light down to the soil surface to encourage germination of new flower seeds. **Remove cut biomass if covers too much** (eg into tree rows if possible). Depends on when it is sown.

- Again at harvest (August-October) (and possible before winter, soil disturbance may benefit seed germination)

Second year

- Cut 2-3 times 8-12 cm adapted to peaks of key natural enemies, apple differentiation, ease of harvest, protecting birds. Perhaps 15-20 cm on machine results in 12-15 cm in field and better result? Removing cuttings may be important especially in N-rich soils.
- Cut 1: during branch crushing after pruning the strip will be cut but better to avoid this by crushing branches before vegetation has started to grow higher.
- Cut 2: after the apple bloom when key flowers have flowered for at least a week and before June 23 (rule of thumb to assure re-flowering the same season in Nordic conditions).
- Cut 3: Before harvest (Voles!)

Third year

- Same as second year but with 12-15 cm above ground
- In the eco-orchard project, no cut before flowering in order to get flowering during the peak aphid period a few weeks after flowering.

Too much grass compared to flowering herbs? Cut higher; 15-20 cm instead?

9 june 2017.

30 august 2017.

Good flowering

Clover and dandelion dominates

Too frequent cutting

Learnings

- Important to remove old vegetation before sowing
- Cutting low first year to help sunlight to reach ungerminated seeds
- Choose flowers which like the soil and the nutrient level in the soil
  - Some flowers in our mix did not like the rich soil
- Management as important as choice of flowers for perennials
  - Plan cutting to benefit flowering when key natural enemies are present – monitoring
  - Mulching or removing grass after cutting very important to keep flower
  - Don’t cut all the flowers at the same time to have continually flowering
  - Cutting at 15 cm (only flower buds cut) will make re-flowering for several species to occur around 4-5 weeks
- Cutting in autumn can be good for next year's establishment
  - Some soil disturbance could be done in autumn spring to benefit seed germination

Experiences from practice

Såteknik – när, hur. Klippning av gräsbanor – när hur.

Fortsatt arbete;

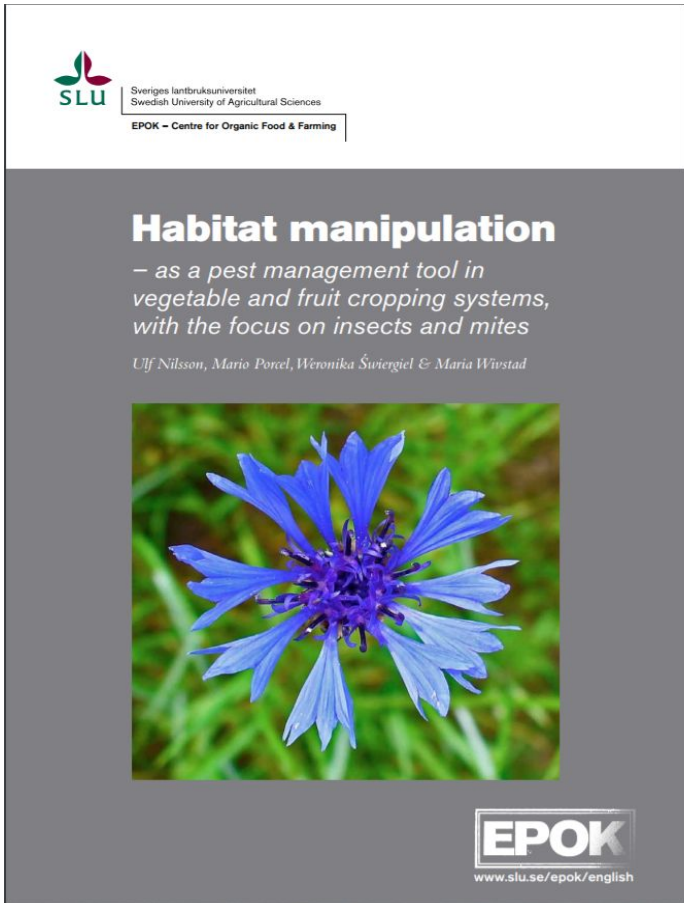
Det vi vill utveckla och hitta lösningar till är dels att

- veta med större säkerhet vilka nyttodjur som gynnas av vilka växter och
- när behovet/skyddet finns så att man inte tar bort det i fel tid.
- Hur vi kan få in blommor, örter och öka nyttodjurens habitat inne i odlingen men samtidigt kunna köra, klippa gräs, ogräsrensa och inte gynna skadedjur samtidigt.

Här känner vi stor tillit till forskningen men i allt arbete är odlarens praktiska vardag och ekonomiska situation den viktigaste grunden.

Funkar det?

Vad säger våra försök och literaturen



http://orgprints.org/30032/1/biokontrollsyntes_web.pdf

https://www.slu.se/globalassets/ew/org/centrb/epok/dokument/habitatmanipulering_se_webb.pdf

T.ex.bladlöss, blodlöss, kvalster

T.ex. skadegörarägg, trips, kvalster, bladlöss, små larver

Examples of natural enemies				
Order	**Latin name**	**Common name**	**Swedish name**	**Prey/host**
Neuroptera	*Chrysoperla* spp.	Green lace-wings	Nätstinkflyn	Polyphagous
Hemiptera	*Orius* spp.	Flower bugs	Näbbskinnbaggar	Polyphagous
Hymenoptera	*Microplitis mediator*	Not given	Not given	Lepidopteran larvae eg. cabbage moth
	Trybliographa rapae	Not given	Not given	Dipteran larvae from the family of Anthomyiidae e.g. the cabbage root fly
	Diadegma semiclausum	Not given	Not given	Diamondback moth
	Diadegma insulare	Not given	Not given	Diamondback moth
	Cotesia rubecula	Not given	Not given	Small white butterfly
	Dolichogenidea tasmanica	Not given	Not given	Leafrollers e.g. *Epiphyas postvittana*
	Colpoclypeus florus	Not given	Not given	Leafrollers
Diptera	*Cyzenis albicans*	Not given	Not given	Leafrollers
	Lypha dubia	Not given	Not given	Leafrollers

Nätvingar!!

Lilla kålflugan

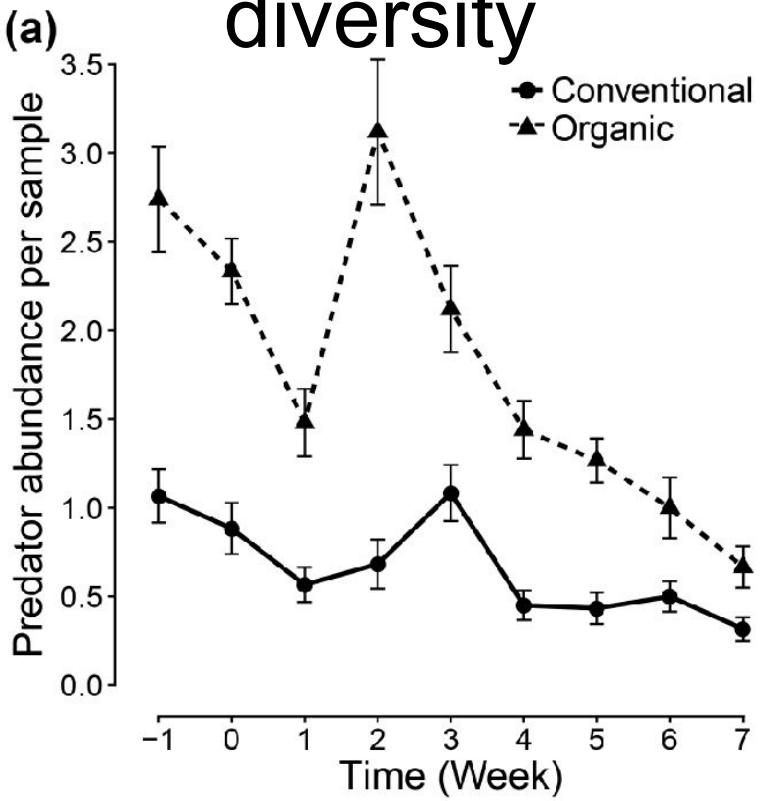
Kålmal

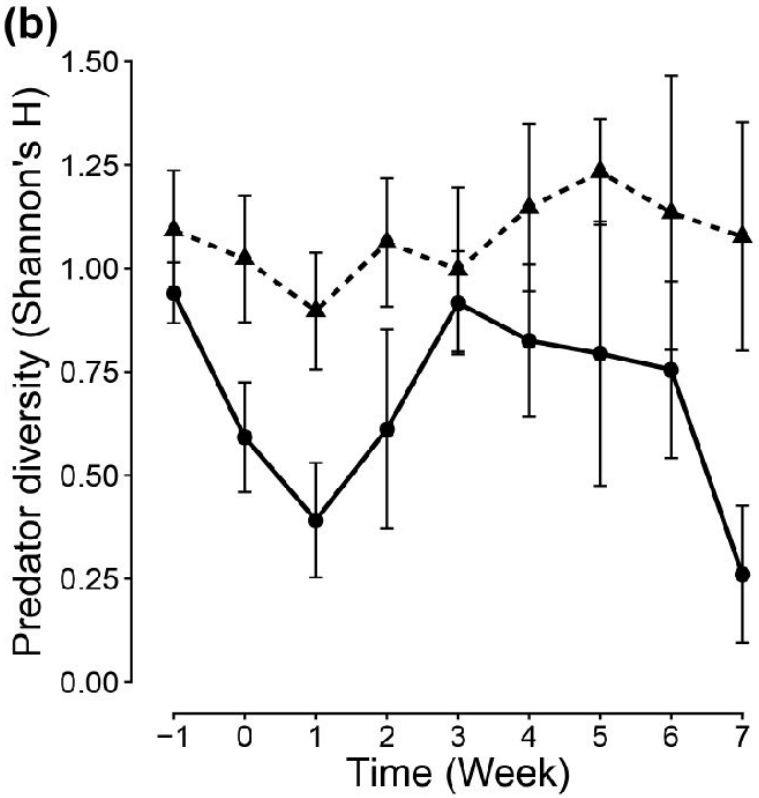
Rovfjäril

Knopp- och bladvecklare

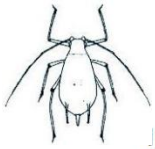
Parasitoid wasps = Parasitsteklar

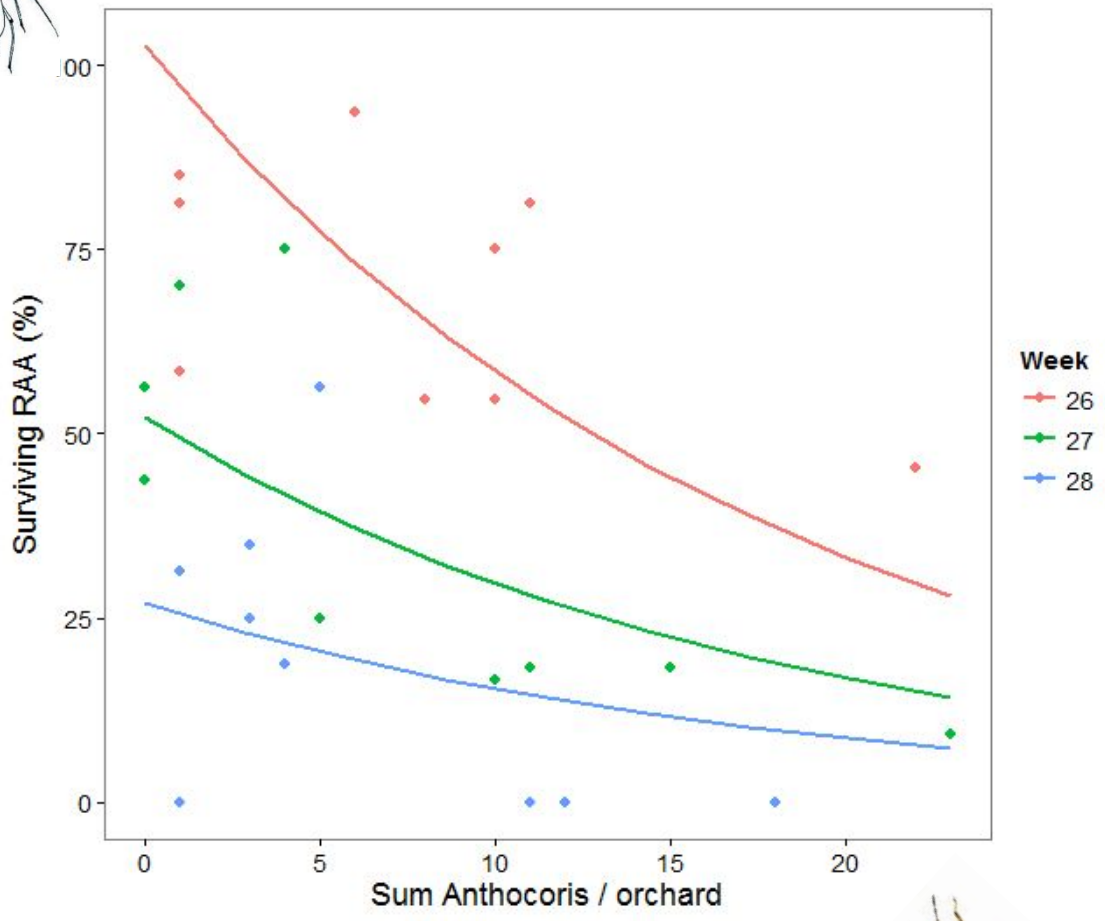
Predators abundance and diversity





The relationship between amount of anthocorid (natural enemy) and rosy apple aphid (pest)





Connecting your key pests to their key natural enemies in time through monitoring and biological knowledge – then plan how to enhance them

An example for a ongoing project on apple production
where growers, researchers and advisors collaborate
to finc es

Monitoring / Övervakning

Visuell kontroll

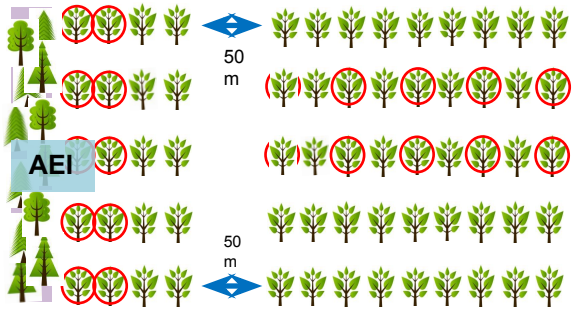
Bankning

Äggpredationskort

Wellpappfällor

Häfte på gång!

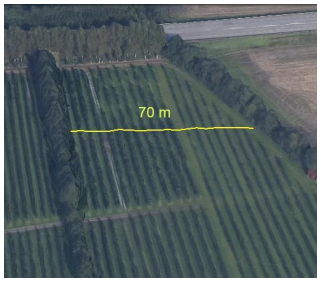
Kräver finansiering för slutförande och översättning till Svenska



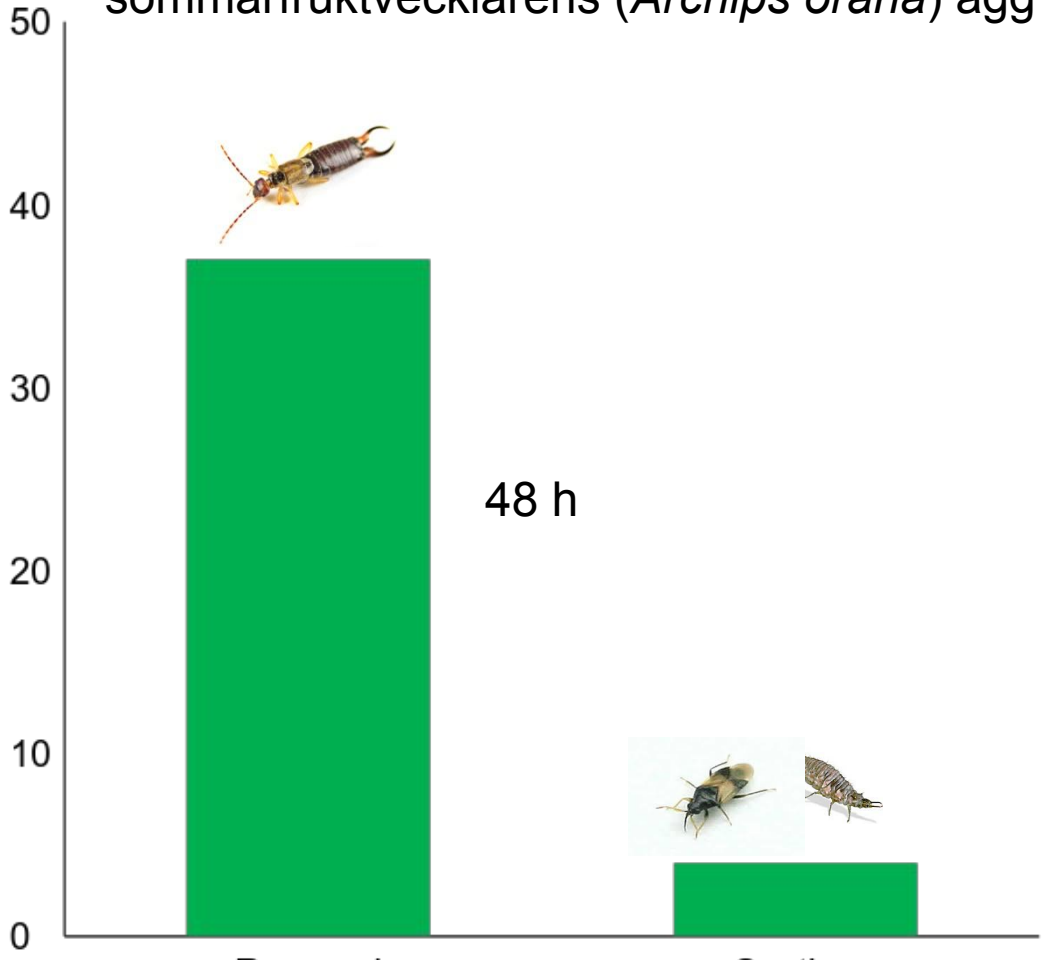
INSTRUKTIONSHÄFTE
ÖVERVAKNINGSMETODER FÖR
NATURLIGA FIENDER
I ÄPPELODLINGAR

2017

Kontaktperson SLU: Weronika Swiergiel weronika.swiergiel@slu.se, vxl 018-671000



Bortförande / utsugning av sommarfruktvecklarens (*Archips orana*) ägg



Main pests in Swedish apple orchards:

Leafrollers

Cydia pomonella

Archips podana

Spilonota ocellana

Adoxophyes orana

Archips rosana

Pandemis heparana

Main pests in Swedish apple orchards:

Rosy apple aphid

Övervakningsmetoder naturliga fiender i äppelodling april/maj till juni.

Naturliga fiender och övervakning

Äggpredationskort
BBCH 67 v22-24

- Rovstinkflyns
- Nätvingar
- Nyckelpigors

Potential att äta Skadegörarägg, röd äpplebladlus, blodlus

Bankning veckan **efter** slut på bladfall (BBCH 69) v 23-25

- Allmänt näbbstinkfly
- Nyckelpigor
- Nätvingar, larver

Nätvingar, mest larver, äter bladlöss, blodlus & kvalster

Tvestjärtar (nymfer) äter bladlöss, bladloppor, blodlus, vecklarägg, kvalster

Ängs- & näbbstinkflyns nymfer och vuxna äter bladlöss,blodlus, vecklarägg, kvalster, unga larver

Nyckelpigor (främst larverna) äter bladlöss, blodlus, kvalster

maj v.18 |  56 Grönt knoppstadie | v.19 | v.20 |  60 - 65 Första blommor öppna / full blom | v.21 | v.22 |  67 - 69 Kronbladen faller av | juni v.23 | v.24 | v.25 | v.26

Rönnbärsmalen vuxna & ägg

Äppelvecklaren vuxna och ägg

+ Andra viktiga **vecklare**

Skadegörare

Övervintrade **blad- och knoppvecklarlarver** äter knoppar och blad.

Äppelvecklarlarver larver

Röd äpplebladlus

Blodlus

Övervakningsmetoder för naturliga fiender i äppelodling juli - sept

Bankning v.27

- Ängsstinkflyn
- Tvestjärtar

Äggpredationskort v 28

- Tvestjärtars
- Rovstinkflyns

Potential att äta Skadegörarägg & blodlus

Wellpapp fällor v 28-31

Tvestjärtar äter

- Röd äpplebladlus
- Blodlus
- Vecklare
- Bladlöss

Naturliga fiender och övervakning

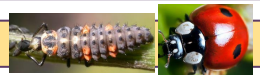
Nätvingar, mest vuxna, äter lite små blodlöss & kvalster

Tvestjärtar äter bladlöss, blodlus, ägg

Tvestjärtar (nymfer + vuxna) äter bladlöss, blodlus, ägg, kvalster

Ängs- & näbbstinkflyn nymfer och vuxna äter bladlöss,blodlus, vecklarägg, kvalster, unga larver

Nyckelpigor (främst larverna) äter bladlöss, blodlus, kvalster



juli				augusti				september			
v.27	v.28	v.29	v.30	v.31	v.32	v.33	v.34	v.35	v.36	v.37	

Skadegörare

Rönnbärsmalen vuxna & ägg

Olika vecklare, vuxna & ägg

Blad- & knoppvecklarlarver (främst A. podana & S. ocellana)

Äppelvecklarlarver larver

Rönnbärsmalens larver

Röd äpplebladlus börjar migrera till groblad.

Röd äpplebladlus migrerar tillbaka till äpple.

Blodlus

Conservation Biological Control
bevarandebiologisk bekämpning

Shelter (skydd)

Nectar (nektar)

Alternative prey (alternativt byte)

Pollen (pollen)

Ackronym påhittad av Steve Wratten
ekologiprofessor i NZ

Supplementary food: Nectar and Pollen

Parasitoide r

•While some parasitoids (parasitoider) are able to obtain needed resources from hosts or do not need to feed at all others require access to non-host foods.

•Floral nectar is taken by many species and can result in increased rates of parasitism.

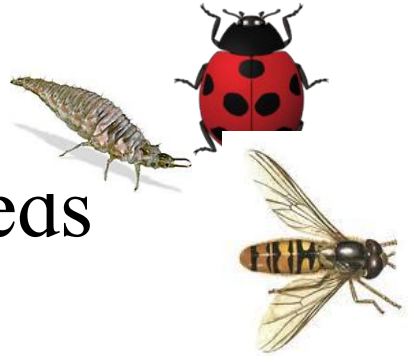
•The flowers that can be used by parasitoids have exposed nectar that they can access (not hidden or superficial).

Phacelia sp.

Strandkrassing

Bovete

Supplementary food:
Nectar and Pollen – flower strips/beds



Flowering period
Nectar accessibility; Floral architechture
Attractiveness; Odour, Colours, Taste, Nutrients (Nectar composition)
Longevity of NE
Note; pests could potentially also benefit…

Buckwheat / *Fagopyrum esculentum* /Bovete

Lacewing / *Crysopidae* / Nätvingar - Guldögonsländor

Chikory / *Cichorium intybus* / Cikoria

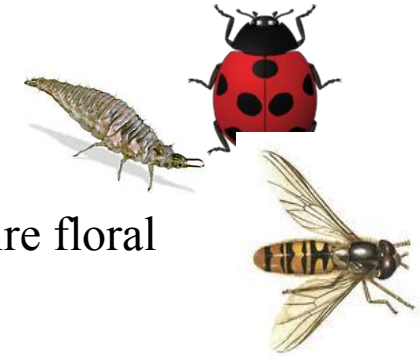
eg. Baggen et al., 1999; Patt el al., 1997; Vattala et al., 2006; Pfiffner & Wyss, 2004; Wäckers, 2005; Wäckers et al., 2007

Supplementary food:
Nectar and Pollen – flower strips/beds

Lettuce aphids and hover flies
http://www.sare.org/publications/insect/chapter3_beneficials.htm

Sweet alyssum,
(strandkrassing)
Lobularia maritima

Supplementary food: Nectar and Pollen



•There are two important groups of predators that require floral resources to survive as adults.

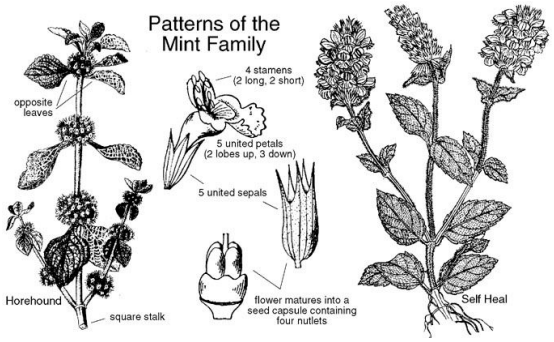
Hover flies / Syrphids / Blomflugor

Lace wings / Crysopids / Nätvingar/ Guldögonslända

Supplementary food:
Nectar – Parasitoid wasps requirements

Previous studies on plant which provided foods for parasitoids wasps have concluded that:

Parasitoid wasps generally have short mouth parts, and feed on nectar, not pollen
Apiaceae / Flockblommiga – shallow nectaries; highly suitable (e.g. cow parsley, coriander)
Lamiaceae / Kransblommiga & Rosaceae / Rosväxter – some species suitable (eg. oregano, mint, wild strawberry)
Asteraceae / Korgblommiga, Fabaceae / Ärtväxter – nectaries deep down in narrow corollas; unsuitable

Lamiaceae family

Apiaceae family

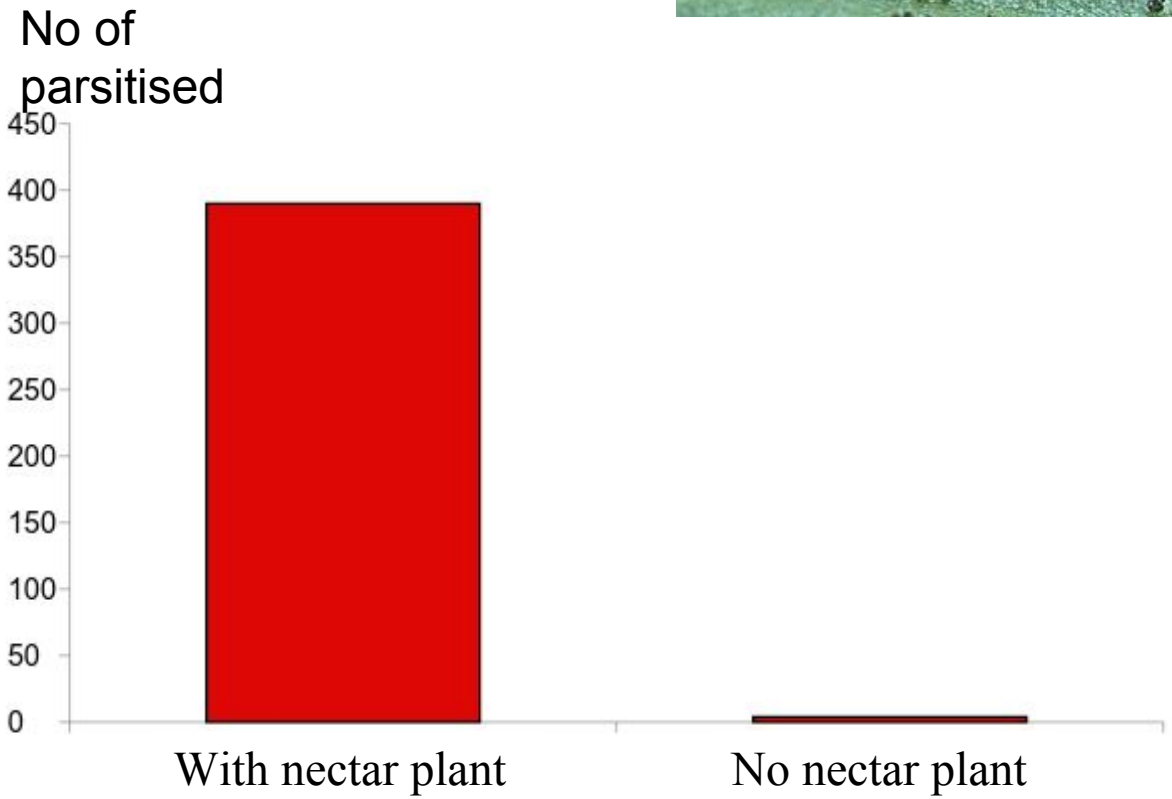
Diadegma semiclausum

Only 3 of 11 females were able to parasitise without nectar. With nectar 100% parasitise.

Longevity:

1,2 days without nectar

28 days with nectar



Winkler et al, 2006. Basic and Applied Ecology photo: B.M Shepard

Supplementary food: Nectar – Parasitoid wasps requirements

Well-studied, suitable plant species for parasitoid wasps. Number indicate reference;
1 = Idris & Grafius, 1995; 2 = Patt et al., 1997; 3 = Baggen & Gurr, 1998; 4 = Winkler et al., 2003; 5 = Wäckers, 2004; 6 = Vattala et al., 2006; 7 = Lee et al., 2006; 8 = Winkler et al., 2006.

Species		Family	References
dill	*Anethum graveolens*	Apiaceae	2,3,4
coriander	*Coriandrum sativum*	Apiaceae	2,3,6
carrot	*Daucus carota*	Apiaceae	1,2,4,5
ground elder	*Aegopodium podagraria*	Apiaceae	5
parsnip	*Pastinaca sativa*	Apiaceae	2
bupleurum	*Bupleurum rotundifolia*	Apiaceae	2
fennel	*Foeniculum vulgare*	Apiaceae	2
parsley	*Petroselinum crispum*	Apiaceae	2
angelica	*Angelica archangelica*	Apiaceae	2
ammi	*Ammi majus*	Apiaceae	2
buchwheat	***Fagopyrum esculentum***	**Polygonaceae**	**4,6,7,8**
borage	*Borago officinalis*	Boraginaceae	3
common figwort	*Scrophularia nodosa*	Scrophulariaceae	1

Supplementary food: Pollen plants

Favours eg. hoverflies, lacewings but also ladybirds, predatory bugs (Orius etc) & predatory midges.

Blåklint/cornflower Maskros/Dandelion Prästkrage/Oxyeye Daisy

Asteraceae; eg. *Centaurea cyanus*, *Taraxacum vulgare*, *Leucanthemum vulgare*

Strandkrassing/Alyssum Bovete/Buckwheat Smultron/Wild strawberry

Others; *Lobularia maritima*, *Fagopyrum esculentum*, *Fragaria vesca, Salix spp.*

Vide/Willow

Pollen quality variable

Experience from bee keepers

eg. Fiedler et al., 2008

Supplementary food: Extrafloral Nectar (EN)

Nectar secreting gland present outside flower; eg. on leaves and stalks

Produces nectar before flowering

Studies have shown that more EN can form as a damage response (i.e. reward for NE); *Vicia faba,* (Bondböna/Broadbean, stipules) (Fabaceae), *Prunus avium*, (Sötkörsbär/Sweet cherry, petiole) (Rosaceae)

Other examples; cotton (Bomull, sepals), Centaurea sp. (Klint/Cornflower, sepals)

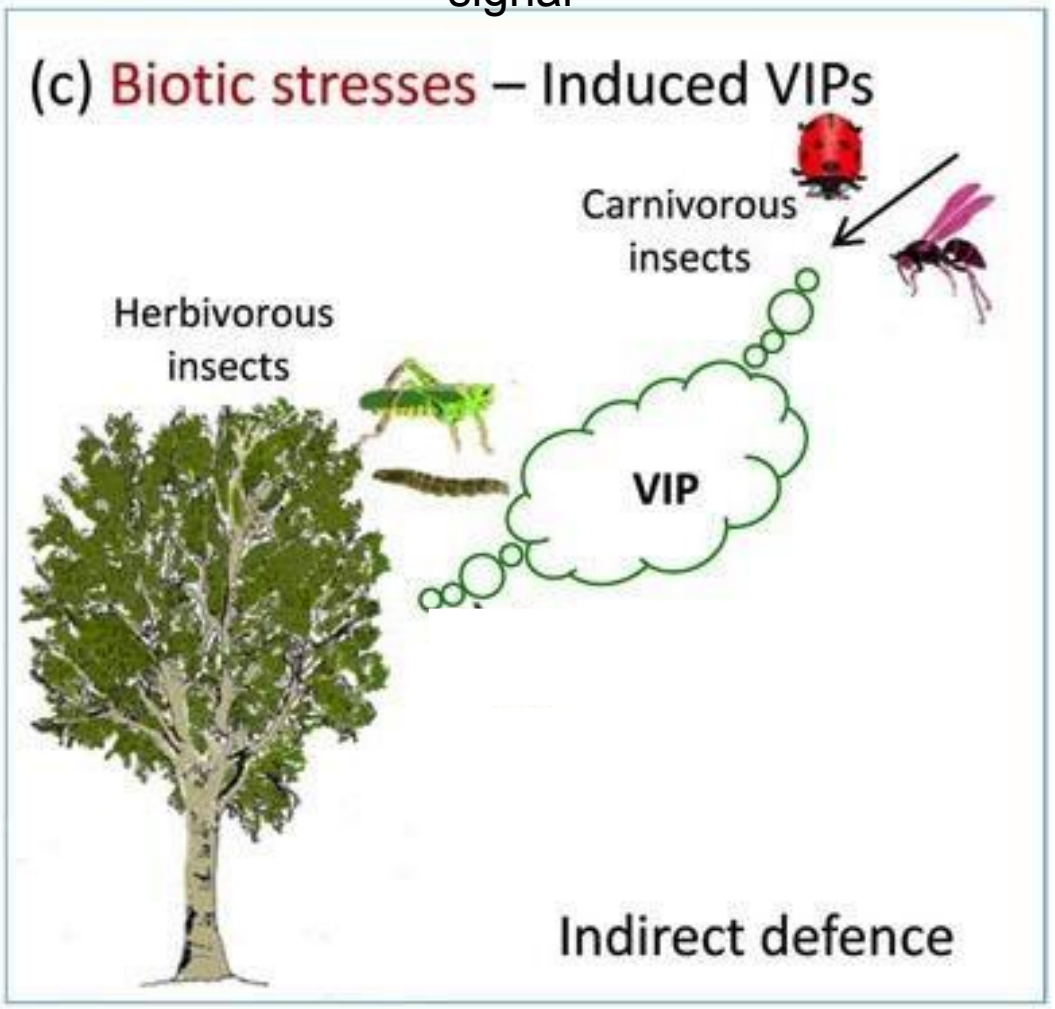
Supplementary food:
Nectar and Pollen – flower strips/beds

Establishment
Placement
Competition with
crops

Greening Waipara - vineyard biodiversity trails - native plants (New Zealand)

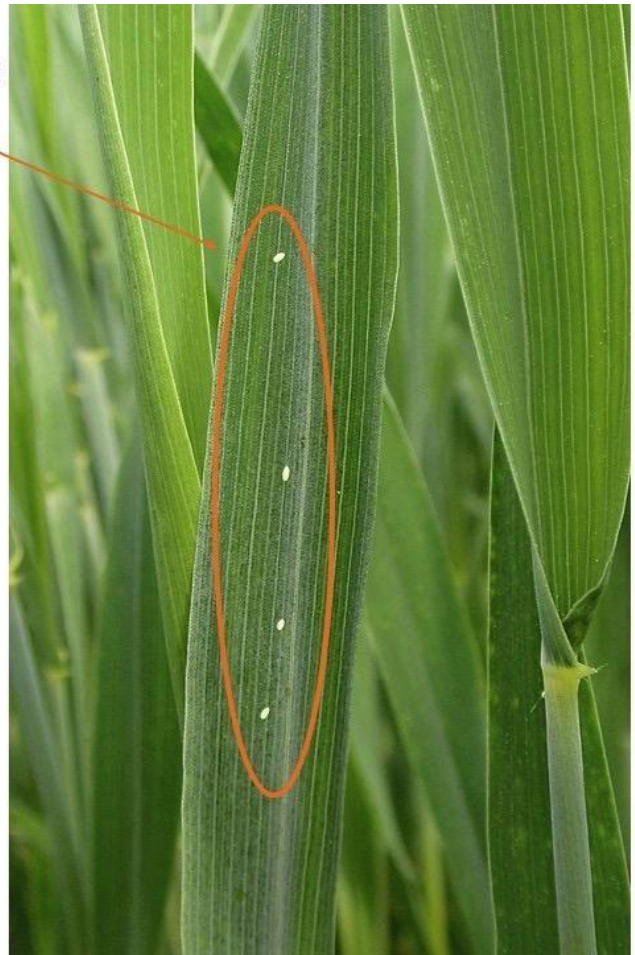
Functional Agro-biodiversity and the "Attract & Reward" concept

Help signal



Help signal: biodegradable formulation (SPLAT, Isca Tech, USA)

de:

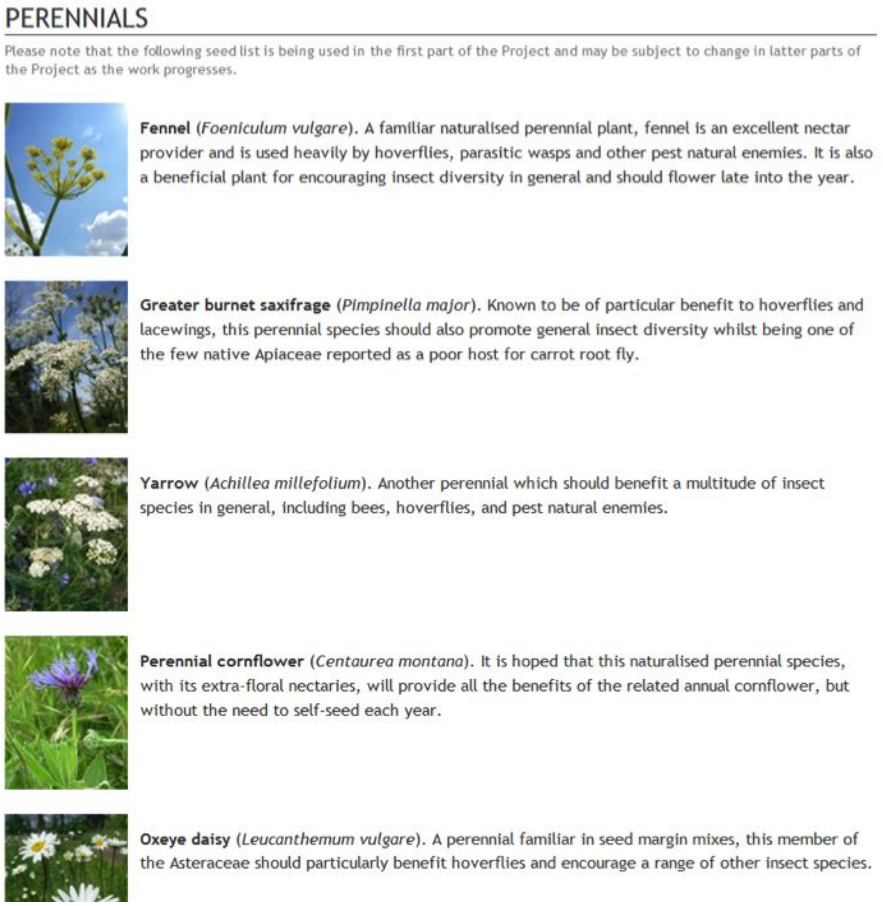


Ecostat - optimising ECOsystem Services in Terms of Agronomy and Conservation

‘Functional Agro-Biodiversity’

Prof Felix Wäckers of Lancaster University

http://www.ecostac.co.uk/seed_list.php



PERENNIALS

Please note that the following seed list is being used in the first part of the Project and may be subject to change in latter parts of the Project as the work progresses.

Fennel (*Foeniculum vulgare*). A familiar naturalised perennial plant, fennel is an excellent nectar provider and is used heavily by hoverflies, parasitic wasps and other pest natural enemies. It is also a beneficial plant for encouraging insect diversity in general and should flower late into the year.

Greater burnet saxifrage (*Pimpinella major*). Known to be of particular benefit to hoverflies and lacewings, this perennial species should also promote general insect diversity whilst being one of the few native Apiaceae reported as a poor host for carrot root fly.

Yarrow (*Achillea millefolium*). Another perennial which should benefit a multitude of insect species in general, including bees, hoverflies, and pest natural enemies.

Perennial cornflower (*Centaurea montana*). It is hoped that this naturalised perennial species, with its extra-floral nectaries, will provide all the benefits of the related annual cornflower, but without the need to self-seed each year.

Oxeye daisy (*Leucanthemum vulgare*). A perennial familiar in seed margin mixes, this member of the Asteraceae should particularly benefit hoverflies and encourage a range of other insect species.

Understorey in apple

CBC of NE of leafrollers (Tortricidae, vecklare) in New Zealand apple orchards (Irvin et al., 2006)

Study species light-brown apple moth, *Epiphyas postvittana* and parasitoid wasp *Dolichogenidea tasmanica*

Lobularia maritima, *Phacelia tanacetifolia*, *Fagopyrum esculentum* tested

Abundance of studied parasitoid higher

Longevity (78%) and fecundity (62%) increased

Parasitism increased with *L.maritima* and *F.esculentum*.

Damage ~30% lower.

Shelter and Microclimate - overwintering sites

Trees and shrubs could be important sources for nectar and pollen, as well as overwintering sites/shelter. In addition berries for birds.
Eg; *Lonicera* spp., *Crataegus* spp., *Prunus* spp., *Sorbus* spp., *Rosa* spp., *Sambucus* spp., *Salix* spp.

Shelter and Microclimate – flower strips/beds

Shelter and Microclimate – field edges

Shelter and Microclimate

Don’t clean too much = overwintering sites!

Mulches (eg. leaves, straw)
Debris and crop residues
Avoid cutting perennials until spring
Dont cut all the grass at once and not too often

Shelter and Microclimate
Beetle banks

MacLeod et al., 2004

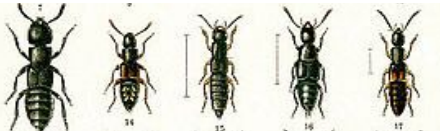
http://www.gwct.org.uk/education__advice/english_entry_level_stewardship/habitat_issues/338.asp

Shelter and Microclimate
Beetle banks

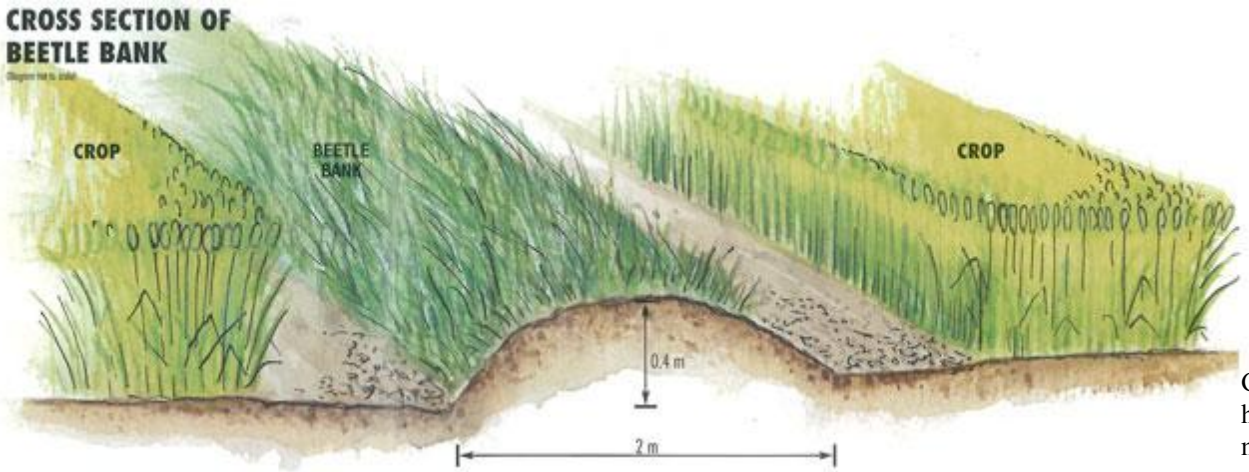
Tussock forming grasses protects against winter temperature fluctuations

Dactylis glomerata – Carabidae (ground beetles)

Holcus lanatus – Staphylinids (rove beetles)



Source of alternative prey
Early crop colonisation prevents pest outbreakes



eg. Landis et al., 2000

Game & Wildlife Conservation Thrust
http://www.gwct.org.uk/education__advice/sustainable_farming/habitat_management/1546.asp

Alternative Host or Prey

Thistle

Aphids

Ladybirds

Alternative Host or Prey

Unruh et al. 2012. Parasitism of leafrollers in Washington fruit orchards is enhanced by perimeter plantings of rose and strawberry.

Parasitic wasps
Colpoclypeus florus

Tortricid pests

Overwinter
5th instar

Rose

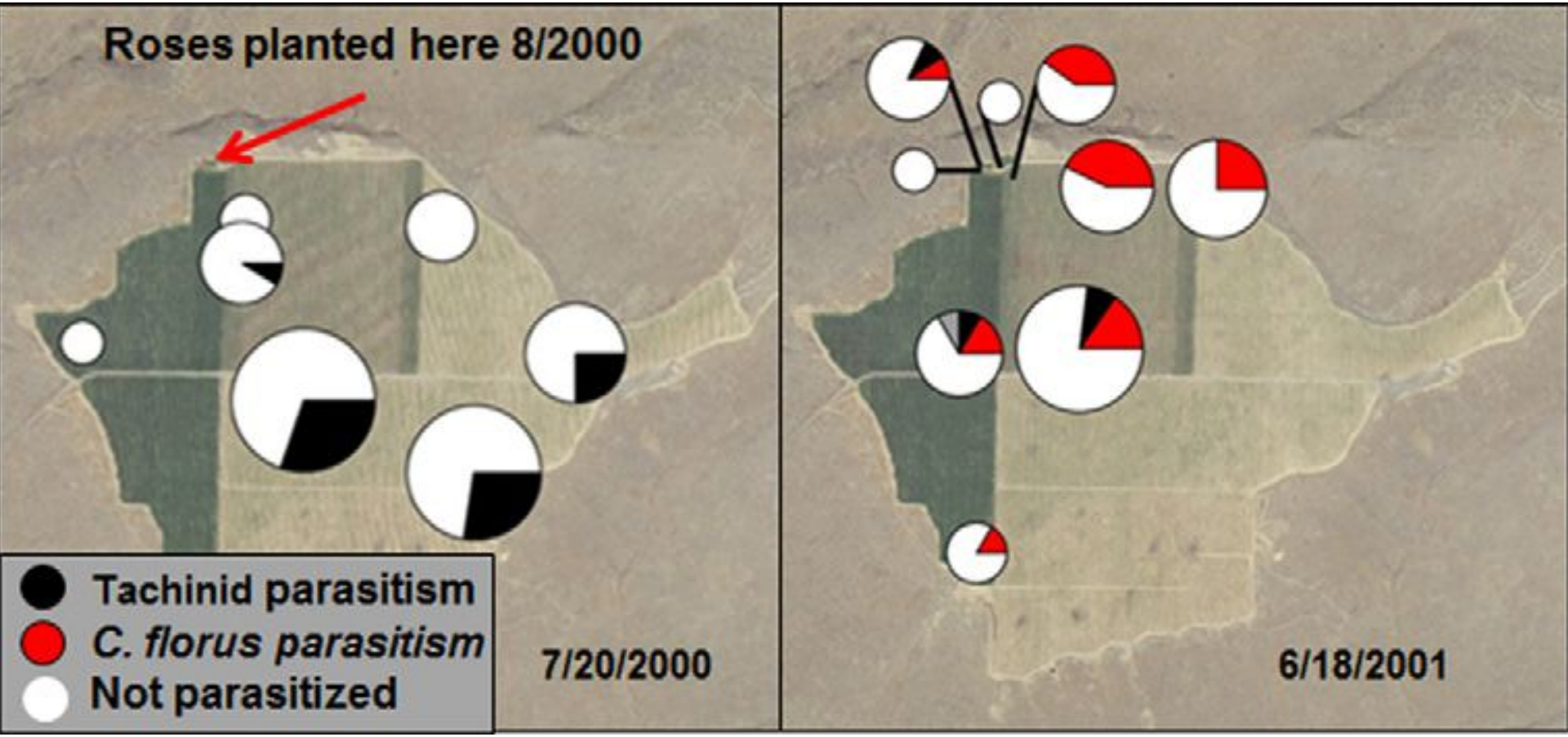
Strawberry

Apple orchards

Tortricid pests

Alternative Host or Prey

Unruh et al. 2012. Parasitism of leafrollers in Washington fruit orchards is enhanced by perimeter plantings of rose and strawberry.



Tack för er uppmärksamhet!

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